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Montana's Energy Resources

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WIND ENERGY SYSTEMS

INTRODUCTION

Montana has some of the best wind energy sites in the country. And some Montanans already harvest power from the wind—power to pump water for their homes, their livestock and their crops; power to heat and light their homes, businesses, farms and ranches; and power to sell to the utility companies. In this pamphlet several Montanans share their experiences with wind power. The pamphlet also includes a guide to wind energy information sources and tips for people considering buying wind power systems.

HOME-MADE ELECTRICITY

Bert Oksness doesn't expect his $10,000 wind generator to pay for itself in the near future, but he's pleased with the machine anyway.

"It's just the idea of having your own power to get away from having to worry about the costs," he says. "Wind energy is like a newborn baby; it takes time to grow. Wind machines are proving themselves. I think in the future they will solve all those little problems, and you'll be able to make money with wind machines."

Perched atop a 60-foot steel tower, Oksness' 1.8-kilowatt Enertech has been generating electricity for his Fairfield home for just over a year. The machine is tied into the Sun River Electric Cooperative so when the generator produces more electricity than the Oksness family needs, the cooperative buys the excess power at .6 cents per kwh. When the wind isn't blowing, the family buys electricity from the coop at 2.6 cents per kwh.

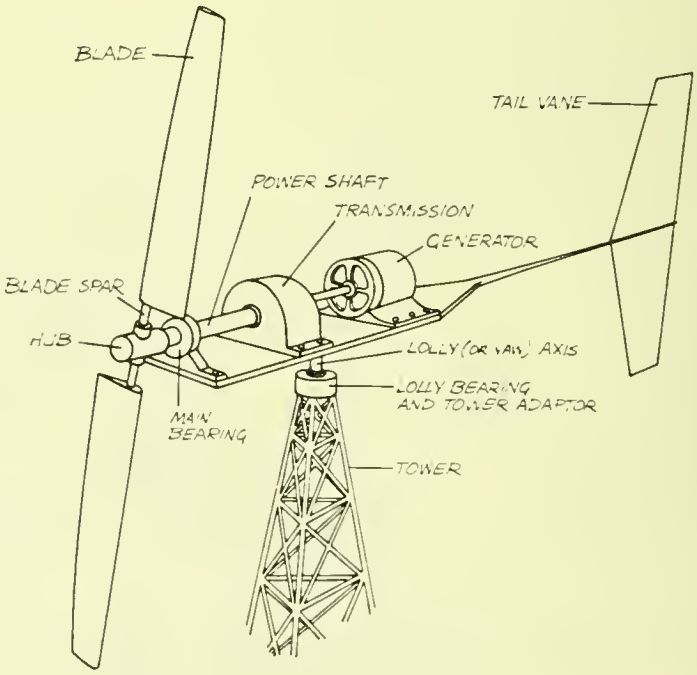
"We've only bought 20 or 30 kwh each month since the Enertech was installed, Oksness said. "I checked the meter just the other night, and it had generated 2,070 kwh and we had used 1,110."

ON THE COVER-A Jacobs 10-kw machine set up east of Livingston. On the back cover-The Montana Windjammer, manufactured by Windpowered Machines of Livingston. The illustrations on pages 2 and 3 are taken from "The Wind Power Book," copyright 1981 by Jack Park. Reprinted by permission of Cheshire Books.

Selecting your dealer is the critical step in buying a wind machine, Oksness warned. "Make sure the dealer has the knowledge and training to install, repair and maintain the machine himself. Don't get involved in a deal where you'll be sending the machine back to the factory all the time because they'll have you over the barrel with long distance phone calls and paying for freight."

Climbing the tower to make repairs, he added, isn't something everyone can do. (Some towers can be lowered for repairs and maintenance.)

Generating wind is only part of the Oksness family's energy campaign. "We practice conservation too," he said. "We have individual thermostats in each room, and we don't use any heaters that are unnecessary. We have a solar panel on the roof for some of our daytime heat. Our highest bill last winter was $27, and the house is totally electric."



An electricity producing wind generator

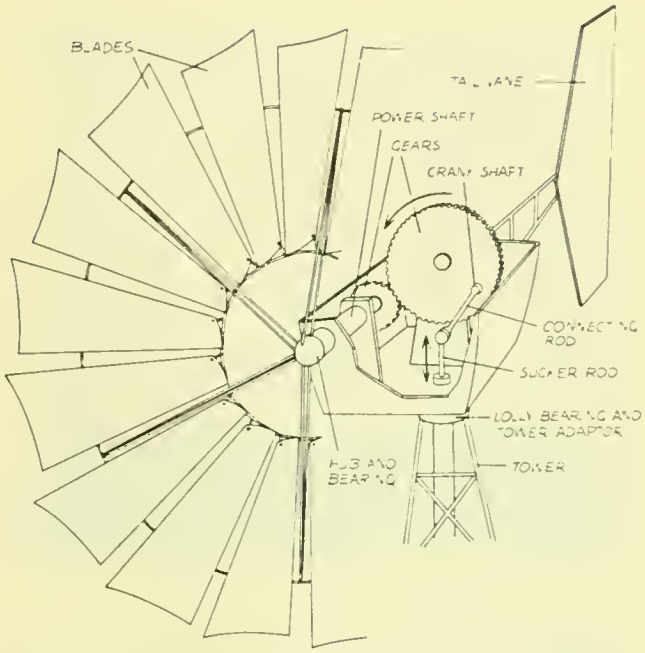
WATER PUMPING

Thirty-five windmills helped solve a problem cattlemen faced on the Fort Belknap Reservation. "We had drought sometimes and high water other times," said Randy Perez.

In a project supported by the Bureau of Indian Affairs, the Fort Belknap Community Council bought 35 Argentinean windmills to pump water to stock tanks on the reservation. Mounted atop eight-foot wooden towers, the windmills provide water for about 8,000 animals on the reservation.

When the windmills first went up in 1978, Perez said, the cattlemen had some problems, but since they replaced the steel sucker rods with fiberglass ones, the windmills have run smoothly. "There isn't much to maintaining them," he added. "We check the oil and make sure there isn't anything coming loose."

The two crucial factors in siting a windmill, Perez said, are having strong wind and "a water table that isn't too deep. We went less than 200 feet down for most of the wells. We have a good location, and the windmills do a good job for us."



A water pumping windmill.

LIVINGSTON HAS WORLD'S FIRST CITY-OWNED WIND FARM

A new kind of farming is just catching on here in Montana. It's wind farming. Using windmills instead of tractors, wind farmers harvest electricity from the wind and sell it to power companies.

The 1978 federal Public Utility Regulatory Policies Act (PURPA), which requires power companies to buy electricity generated by independent producers, blew life into the wind farming movement.

One of the first to take action was the City of Livingston. The city put four 25-kilowatt wind generators on Harvat's Flat, a benchland visible from Interstate 90 east of town, and thus created the world's first municipal wind farm. The farm was started with a $222,000 renewable energy grant from the Montana Department of Natural Resources and Conservation (DNRC) and $3,300 from the U.S. Environmental Protection Agency.

The windmills were tied into the Montana Power Company grid in December 1981. Despite nearly four months of shutdowns, the wind farm sold Montana Power Company over $7,000 worth of electricity in its first year of operation.

"We'd planned on a lot of down time the first year because of the newness of the technology," said Ed Stern, Livingston's director of community development. "It takes time to get everything going just right, and we'd allowed for that. The windmills are working well now."

A 25 percent federal business investment tax credit coupled with Montana's 35 percent commercial investment tax credit has attracted private firms to wind farming.

The Livingston area with its exceptionally strong winds has drawn interest from as far away as Holland. If all the energy companies that have expressed interest in Livingston were to go ahead with their plans, there could be 9,000 windmills sweeping electricity out of the Park County wind. Those wind machines would cost over $400 million and spread out over 8,000 acres of land. Under peak conditions, they could produce 200,000 kilowatts; that's half as much as Colstrip 1 or 2, or about enough power to light a third of the homes in Montana.

Investing in the wind, Stern explained, is like investing in the stock market. "Just investing in the stock market isn't necessarily going to make you money; you've got to buy the right stock to make money. In wind you've got to have the right site for it to pay off. You've got to research your wind site just the way you would research a stock you were going to put thousands of dollars into."

The Livingston Wind Farm.

While some parts of Montana are rich in wind resources, like the Livingston Wind Farm area with its average annual wind speed of 16 miles per hour, others are not. And wind is very site specific. Just because your neighbor two miles down the road has enough wind to generate electricity doesn't mean you do, too. The first step most wind experts recommend is installing a recording anemometer to measure the wind at your specific site. Gathering a full year's worth of data is usually recommended if you're considering an electricity generating wind machine.

Many wind generators don't even start turning until the wind is blowing eight or nine mph. The general rule of thumb is that you need an average annual wind speed of 10 mph to generate electricity, although sail wing and water pumping models work at lower wind speeds.

Since the power available to your wind generator increases with the cube of the wind speed, a small difference in wind speed can make or break your wind project. The increase from 10 to 12 mph is only a 20 percent increase in wind speed, but it creates an 80 percent increase in power production.

The data gathered with a recording anemometer can not only tell you whether or not you have enough wind to make a wind machine pay off, but it can also help you decide which machines are best suited to your site. The different models have various cut-in speeds, generate peak power in various wind speed ranges and automatically cut out at different speeds. The anemometer can give you a profile of your wind resources that you can match to the performance profiles of the different wind machines.

Like any other farming, wind farming has its risks. Generally, fewer than five years' worth of operational data are available on wind turbines, especially the giant utility-sized machines. They are still relatively expensive because most of them are not yet mass produced.

Although they have fewer environmental impacts than most other electrical generating technologies, wind turbines do have some drawbacks. Among the potential problems are: electromagnetic interference, noise, aesthetics and safety. Most of these impacts can be lessened by siting the wind farm away from areas of human activity.

Research going on today should help mitigate the negative impacts of wind turbines and bring down their costs. Extensive research programs are being carried out by wind machine manufacturers and by the federal government with its Rocky Flats Wind System Testing Program in Colorado. The State of Montana encourages research and development with grants and loans through the Renewable Energy and Conservation Program administered by DNRC.

As more and more wind machines go up, we should see the problems being solved and costs going down. Wind could easily become one of Montana's best sources of energy—abundant renewable and virtually non-polluting energy.

A Dutch Holec machine put up at the Livingston Wind Farm by private investors.

BEFORE YOU BUY A WIND SYSTEM . . .

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Can I Use Wind Energy To Lower My Utility Bills?

Maybe! To use wind energy effectively your site must be free of buildings that might obstruct the wind. And you must have enough wind.

How Do I Know If I Have The Wind?

Installing an anemometer and measuring the speed of the wind is the only way to tell for sure. Guessing won't do. Many people overestimate the amount of wind available to them. Don't! It could lead to a costly mistake.

The anemometer must not only measure wind speed but must also record it as well. Simple indicators of instantaneous wind speed are useless.

Recording anemometers and suitable towers can be purchased for approximately $500. Used or secondhand anemometers are sometimes available. Anemometers can also be rented.

How Can Wind Energy Be Used?

Modern wind turbines are designed primarily to generate electricity. Consequently they can be used in any application requiring electric power. Most wind generators produce line-quality power compatible with that from the local utility. When a wind generator is connected to the power company grid, the power company buys any electricity you produce in excess of your own needs, and you buy electricity from the power company on windless days. This has nearly eliminated the need for the batteries commonly associated with the home wind-powered generators of the 1930's. Only in those rare cases where existing utility service is unavailable or too costly are batteries needed for windless periods.

Some wind machines are intended to provide mechanical power for tasks like pumping water.

Are Wind Turbines Economical?

Yes, in certain locations. Wherever there is both sufficient wind and a high cost for conventional energy a wind turbine may be a good investment.

How Can I Find Out?

No one can tell you with absolute certainty when a wind turbine will pay for itself or define the relative worth of the investment for you. There are too many variables involved. Professionals with experience in wind energy, though, can give you a fair idea of what to expect. A good investment should pay for itself within 10 years.

What Do They Cost?

For homeowners: $7,000 to $30,000
For farms and small business: $20,000 to $50,000+
For industrial applications: $50,000+

Wind turbines are expensive. There's no escaping that fact. But their fuel is free! The question is whether or not a wind turbine will be a good investment. Don't let the initial cost fool you. Your wind machine will be saving you money for years to come.

Can I Build One Myself?

Not likely. Even if you could, it probably wouldn't work reliably. It would also end up costing a lot more than you'd expect. Don't even attempt building a wind generator yourself unless you're a skilled mechanic, you've got good engineering sense and you've got plenty of liability insurance. Wind is a capricious resource capable of tremendous force. Don't underestimate it. Even the manufactured systems designed by experienced engineers have been known to unexpectedly disintegrate.

Well Then, Who Builds Wind Turbines?

There are more than 50 manufacturers in the country, including one in Livingston, MT, and an equal number abroad. They build wind machines in all sizes and shapes. Some models work flawlessly, others have a history of failure. To find out what products are available, check with someone in the wind machine industry.

What Do They Look Like?

Modern wind turbines come in many different configurations. The blades of some rotate about a horizontal axis like the windmills of old. Others, such as the Darrieus or "eggbeater" turbine, rotate about a vertical axis. Nearly all of today's machines use only two or three slender airfoils for blades. They actually capture much more energy from the wind than multiblade turbines such as the farm windmill.

What Size Do I Need?

First, determine your electrical consumption. The typical Montana household uses about 400 to 500 kwh a month for lighting and appliances. If a home is electrically heated, it can use as much as 3,000 to 4,000 kwh a month.

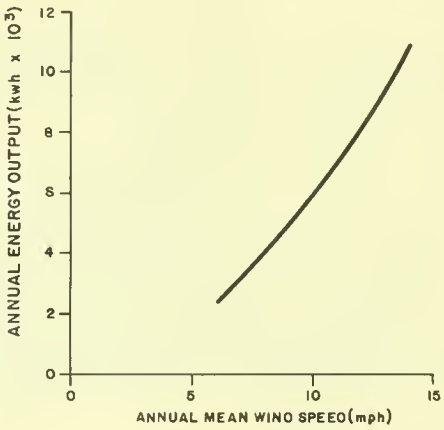
Next, estimate the energy output of several different size wind machines for an area with your average wind speed. Then find the turbine size that best meets your needs.

If your utility pays less than the retail rate for power they buy back, a wind machine smaller than

your total consumption will be best. On the other hand, if they pay more for any excess power you may generate than they charge for power, a wind turbine as large as is feasible will be a better buy.

How Can I Estimate Output?

Most manufacturers now provide with their sales brochures estimates of the annual energy output of their turbines. The annual energy output rating is the wind industry's equivalent to EPA's mileage label on new cars. This information will appear either as a graph or as a table of energy output versus average wind speeds as illustrated below. Several publications listed later in this brochure describe techniques for determining wind machine output.



ENERGY COSTS AND
ANNUAL ENERGY OUTPUTS

What's Included In The Price?

It varies. Several companies provide their own specially made towers and include their cost in the list price. Others don't. Always check to see if a tower and installation are included.

How Can I Judge Reliability?

Talk to current owners of the wind turbines you're considering. Does it deliver on the company's claims? Dealers should have names available for such purposes; if yours doesn't, find another dealer. You could also hire a private consultant familiar with the industry for an unbiased opinion.

It's worth the trouble it takes to check reliability. A solid dependable wind turbine will bring you years of service but a lemon will bring you years of agony.

How Can I Tell If A Dealer Is Reputable?

Check with their previous clients. Has the dealer been prompt in making repairs or has the dealer dallied while making new sales?

How Can I Ensure That I Get What I Pay For?

Put it in writing! Demand a written warranty and have your attorney check it. A wind turbine is a major investment, and it's well worth the added cost of getting good legal advice.

Keep dealers honest. If they make a claim, have them put it in writing and make them stand by it.

Reserve complete payment until you're satisfied the wind generator is performing as advertised. A performance bond of 10% to 15% of the total price should be held until the dealer has kept his side of the bargain.

Are There Any Laws Against Windmills?

Yes. Some zoning ordinances prohibit wind turbines. You should have no problems in an unzoned area. Nevertheless, talk to your neighbors first. They might object. And if they do, it's better to hear from them informally than in court.

Will The Utility Allow Interconnection?

Contact someone at your local utility company for more details on interconnection provisions. There are safety and insurance requirements your turbine must meet.

Do I Need Insurance?

Yes. You should not only have insurance on the wind system itself, but you should also have liability insurance for any accidents due to the wind turbine. Insurance is necessary because unexpected events could destroy an expensive wind system before you recoup your investment.

Is Government Assistance Available?

No. If you want a wind system, you'll have to pay for it. However, purchasing a wind turbine will qualify you for substantial federal tax credits.

For residential applications, a credit of 40% can be earned on purchases up to $10,000. In commercial applications, businesses can claim 25% of the turbine's installed cost as a tax credit, with no upper limit.

The credit, because it reduces your tax liability, lowers the initial wind system cost. The federal tax credits are good up to 1985.

There's also another tax advantage. The savings from a wind generator are tax free. If you fall within the 25% tax bracket, $1,000 in tax free revenue is worth $1,333 of taxable income.

Montana Tax Credits

Residential installations qualify for up to $125 of credits on the Montana income tax while commercial investments receive a 35% credit on wind-generated income. The commercial tax credit is not a tax shelter; it may be applied only to income from wind generation. Wind systems in Montana are also eligible for a 10-year property tax exemption up to $20,000 for a single-family residential installation and up to $100,000 for a multi-family residence or non-residential structure.

Grants and Loans

DNRC supports research into wind and other renewable energy sources with grants and encourages commercialization of wind and other renewable sources through its loan program.

An Enertech machine goes up near Ulm.

FURTHER READING

Common Sense Wind Energy . . . California Office of Appropriate Technology; Brick House Publishing Company, 34 Essex St., Andover, MA 01810, 1983, 83 pp., $8.95. Covers the fundamentals of figuring your energy needs and siting, selecting, buying and installing wind systems for pumping water, producing process heat and running appliances.

Harnessing The Wind For Home Energy . . . Dermot McGuigan; Garden Way Publishing Co., Charlotte, VT., 05445, 1978, 134 pp., $4.95. How-to book on measuring your electric needs and selecting appropriate systems. Describes working installations.

Home Wind Power . . . United States Department of Energy; Garden Way Publishing Co., Charlotte, VT 05445, 1981, 203 pp., $10.95. Covers site evaluation, installation, economics, monitoring and maintenance of a home wind system.

The New Alchemy Water Pumping Handbook . . . Gary Hirshberg; Brick House Publishing Co., 34 Essex St., Andover, MA 01810, 1982, 141 pp., $8.95. A guide to designing and building water pumping windmills. Although it emphasizes sail wing models, the basics apply to all types of water pumpers.

The Wind Power Book . . . Jack Park; Cheshire Books, 514 Bryant St., Palo Alto, CA 94301, 1981, 253 pp., $14.95 in paperback or $21.95 in hardcover + $1.50 postage. Covers siting, economics and design of small wind energy systems, including both basic and technical information.

Wind Power For The Homeowner . . . Donald Marier; Rodale Press, Emmaus, PA 18049, 1981, 368 pp., $16.95. Aimed toward homeowners who want to install their own systems, this guide covers selecting, siting and installing electricity generating wind systems.

A Siting Handbook For Small Wind Energy Conversion Systems . . . Harry L. Wegley, Montie Orgill and Ron L. Drake, available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, 1978, 113 pp., $6.50. Order #PNL-2521. Based on 50 years of siting experience.

Periodicals:

Alternative Sources of Energy, 107 S. Central Avenue, Milaca, MN 56353, $19.50/year, six issues; **Renewable Energy News**, P.O. Box 182, 1337 "K" St. N.W., Washington, DC 20005, $28.00/year, monthly; **Wind Power Digest**, P.O. Box 700, Bascam, OH 44809, $12.00/year, quarterly; **Wind Energy Report**, P.O. Box 14, Rockville Center, NY 11571, $125/year, twice monthly; **Wind Industry News Digest**, Alternative Sources of Energy, Inc., 107 S. Central Avenue, Milaca, MN 56353, $36.00/year, monthly; and **Windletter**, American Wind Energy Association, 2010 Mass. Avenue N.W. 4th Floor, Washington, DC 20036, $35.00/year with membership.

OTHER DNRC WIND PUBLICATIONS

The following publications are available free from the Energy Division, Montana Department of Natural Resources and Conservation, 32 South Ewing, Helena, Montana 59620:

Small Wind Energy Conversion Systems, a 54-page introduction to generating electricity from the wind.

Wind Energy Pathfinder, a bibliography.

SWECS Economic Calculations: non-business applications, which describes techniques for estimating the economic viability of an electricity generating wind machine for residential use.

Montana Renewable Energy Handbook, a 114-page book that covers the basics of wind energy along with other renewable resources.

Montana Wind Atlas, a compilation of all the wind data available for Montana. This book is designed to help wind prospectors locate the best sites for wind farms in Montana.

Montana Energy Tax Benefits, includes information on the tax credits available for using wind energy.

free from

DNRC Energy Division
Capitol Station
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Montana Department of
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